Journal
Of
Minimum Intervention In Dentistry

Minimum Intervention Treatment Plan (MITP) – practical implementation in general dental practice.

Doméjean-Orliaguet S[1], Banerjee A[2], Gaucher C[3], Milètic I[4], Basso M[5], Reich E[6], Blique M[7], Zalba J[8], Lavoix L[9], Roussel F[9], Khandelwal P[9]

Abstract

The Minimum Intervention (MI) concept is well described in the literature and summarizes the clinical rationale for the preventive and cause-related approach in the management of dental caries. The GC Europe "MI Advisory Board" which is a Pan-European group of clinical academics and general dental practitioners aims to present an evidence-based, patient-centred MI treatment approach for use in routine dental practice. This treatment methodology is based on four phases of treatment planning: MI Identify, MI Prevent, MI Recall and MI restore. MI Identify: en-compasses detection of dental caries and identifying factors affecting the susceptibility of the individual patient. A modified ICDAS detection scoring system is presented to relate the visual appearance of lesions with the histological process and is related to the clinical signs of caries and radiological invest-igation. In addition, assessment of plaque and saliva is discussed using commercially available chairside kits. All this infor-mation can then be evaluated to assess the patient's suscept-ibility, establish a diagnosis and set up a preventive MI treatment plan. MI Prevent and MI Recall: Depending on the susceptibility and the risk factors of the patient, preventive treatment regimens can be instituted. The "standard" approach includes oral hygiene instruction, dietary advice, patient motivation and maintenance. Those patients with high risk factors need "active" preventive care. This includes the measures to decrease the bacterial content of the oral cavity, placement of transitional restorations and use of remineralisation agents. Repeated diagnosis of the risk factors will be used to assess the need for the precise level of preventive measures and the amount of recall sessions individualized for each patient. MI Restore: MI Restore presents techniques for conservation of tooth structure when restorations have to be placed. Distinctions are made between non-invasive and invasive techniques.

Corresponding author:
Sophie Doméjean-Orliaguet, DDS, PhD
Senior Lecturer
Dental school, Department of Operative Dentistry & Endodontics
11 Boulevard Charles de Gaulle
63000 Clermont-Ferrand, France
Tel: +33 4 73 17 73 18
Fax: +33 4 73 17 73 06
E-mail: sophie.orliaguet@u-clermont1.fr

[1] University of Auvergne, EA 3847, France
[2] King's College London Dental Institute at Guy's Hospital, King's College London, UK
[3] University of Paris Descartes, France
[4] University of Zagreb, Croatia
[5] University of Milano, IRCCS Istituto Ortopedico Galeazzi, Italy
[6] University of Cologne, Germany
[7] Nancy, France
[8] Pamplona, Spain
[9] GC Europe, Belgium

Introduction

Minimum Intervention (MI) dentistry is a concept based on a better understanding of the caries process and the development of new diagnostic technologies and adhesive, bioactive restorative materials. MI can be defined as an approach for dentists to base their treatment plans on four key-points[1]:

1. A comprehensive diagnosis of the disease (caries risk assessment/ susceptibility, early lesion detection);
2. The possibility to prevent caries and to remineralise early lesions;
3. Where necessary, minimally invasive operative treatment including refurbishment of previous restorations rather than their systematic replacement;
4. Patient education.

This concept has been evolved over a decade, by many experts, and is based on sound evidence-based principles[1-9]. However, international consensus guidelines for its implementation in clinical practice are still lacking despite the growing literature. Studies have investigated the treatment decisions used in clinical practice and have shown wide variation in criteria between and within practitioners in different countries. They highlighted that dental practitioners still suffer from a lack of clarity on how to tailor a treatment plan to the individual needs of the patient.

A pan-European group of dental clinicians and clinical academics co-ordinated by GC Europe – namely the GC Europe MI Advisory Board - has developed a "Minimal Intervention Treatment Plan (MITP)". The hope is that this simple and practical protocol, outlined in the following paper, could be developed and used by dentists working in different countries, under different health care systems and environmental pressures.

The minimum intervention treatment plan (MITP)

The basis of the MITP framework is shown in Figure 1 and is composed of four key phases of patient-centred treatment interlinking with each other: *MI identify (*disease experience, aetiology and risk of the individual patient); *MI prevent* (prevention of loss of tooth surface integrity or of further disease); and *MI restore* (non-invasive and minimally invasive therapies). A fourth key stage is the *MI recall* phase, vital in order to maintain oral health at a level suitable for the patient's needs. This stage can be inserted at any point in the cycle, dependent on the individual's requirements for maintenance of oral health.

Figure 2 shows a generic flowchart of the practical implementation of MITP. Its primary objective is to clarify and simplify patient-centred management path-ways, which a dental team could follow together with the patient.

MITP first phase - MI IDENTIFY

The *MI Identify* phase can be divided into the following practical stages and each will be briefly discussed in the following sections:

Anamnesis - the process of verbal history taking

The skill of verbal history taking is taught at dental school and thereafter practiced and improved upon as clinical experience is gained. Computer software or hand-written notes / charts / tables can be used to assist in a systematic approach to this task ensuring no vital information is omitted. After ascertaining the reason for the visit, a relevant dental, social, behavioural

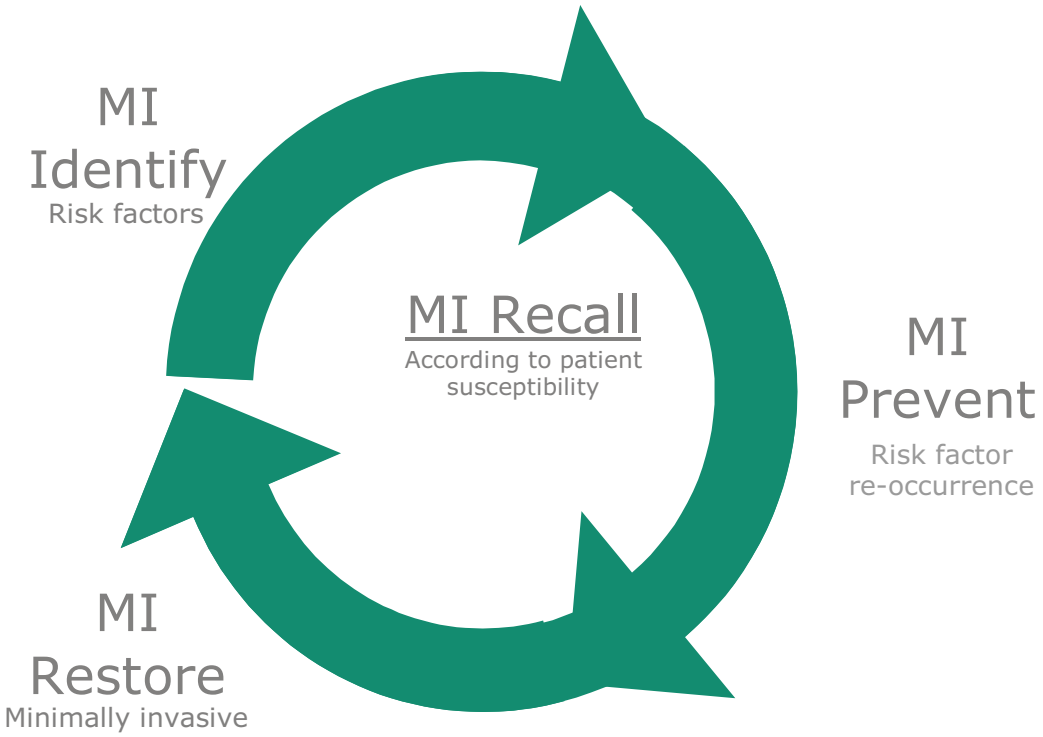


Figure 1: The patient-centred management cycle on which MITP is based. The recall component can enter the cycle at any point dependent on individual patient needs.

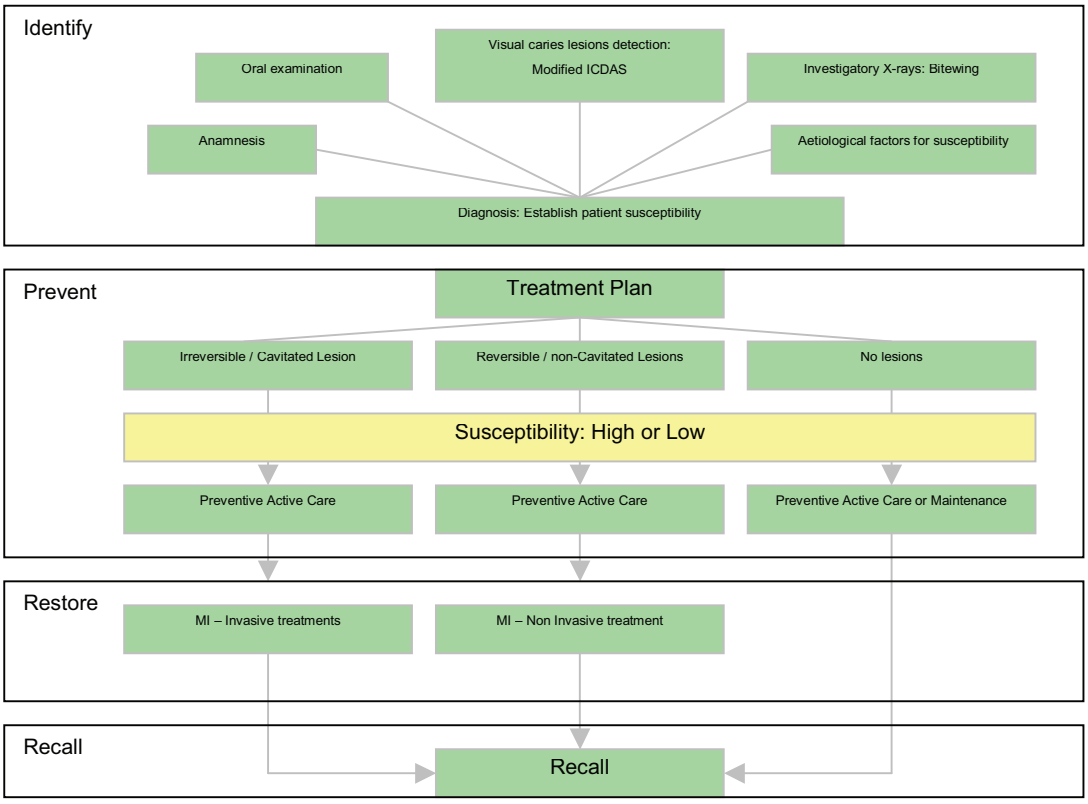


Figure 2: The MITP flowchart - bringing the patient-centred MI philosophy into general dental practice.

and medical history must be evaluated. Important information regarding dietary habits, oral hygiene procedures, past dental history and overall patient motivation can all help create a picture regarding the caries status and susceptibility of the individual patient.

Oral examination

After assessment of the soft tissues and periodontal status, priority can be given to the teeth themselves. The visual examination has to be performed on clean, dryable tooth surfaces, with the advisable use of magnification and good quality lighting. It is essential to define /detect the different stages of the caries process (from early enamel demineralisation to frank cavitation) in order to adapt the therapeutic option (from a remineralisation therapy to a restoration).

In 2005, the International Caries Detection and Assessment System (ICDAS) Foundation was set up to develop a "standardised" visual scoring system for use in dental education, research and clinical practice[10,11]. This scoring system has been modified by the group and adapted for ease of use in clinical practice, and is outlined in Table 1. The use of a sharp dental explorer is no longer recommended, due to the risk of unnecessary damage to the hard tissues[12,13]. The ICDAS committee recommended the use of a ball-ended explorer for caries detection, which is used gently across a tooth surface to confirm the loss of enamel surface integrity. In conjunction with visual examination, bitewing radiographic investigation has to be undertaken to help detect early approximal lesions[14]. Bitewing radiographs allow the follow-up of early lesions for which a stabilisation / remineralisation therapy has been indicated.

Other clinically useful tools for early detection (e.g. laser fluorescence) are still under development or under clinical investigation for further validation and discussion is out with the scope of this paper[15].

Factors affecting patient susceptibility to caries

There are numerous factors (see Table 2) that have been recognized to affect an individual's susceptibility to caries. This data can be obtained from both examination stages above and once gathered, must be processed to help make the final diagnosis and prognosis for the individual patient. This information must be used wisely to permit the appropriate treatment pathway to be followed and a simple, less ambiguous favourable/unfavourable (low/high) susceptibility rating is proposed (Table 2). Table 2 outlines some of the more easily discernible factors that might be elucidated from the verbal history and oral examination. A chart similar to Table 2 could be used clinically to augment the patient notes and provide objective longitudinal analysis of how the individual's susceptibility might change over time. Furthermore, this level of record taking is essential for the ultimate engagement and education of the patient.

MITP second Phase - MI PREVENT

"Preventing the loss of the tooth surface integrity" is a challenge for the dental profession for the 21st century[16]. This includes the global management of the caries process as well as all the other causes of the loss of mineralised tissues, e.g toothwear. The MITP aims to organize a global approach based on rational recommendations and following the holistic concepts of health and welfare, as illustrated in the flowchart (Figure 2). Two aspects of preventive care are described according to the patient susceptibility and the presence or not of cavitated

Table 1: A modified ICDAS 5-point visual scoring system to be used in general dental practice. Green captions describe the visual appearance of occlusal / smooth surfaces and the associated black captions, the equivalent histological features of the lesion. The clinical images provide examples of each score.

0			No or slight change in enamel translucency after prolonged air drying (>5 s). No enamel demineralisation or a narrow surface zone of opacity
1			Opacity or discolouration hardly visible on a wet surface, but distinctly visible after air drying. Enamel demineralisation limited to the outer 50% off the enamel layer
2			Opacity or discolouration distinctly visible without air drying. No clinical cavitation detectable. Demineralisation involving between 50% of the enamel and the outer third of dentine.
3			Localised enamel breakdown in opaque or discoloured enamel +/- greyish discolouration from underlying dentine. Demineralisation involving the middle third of
4			Cavitation in opaque or discoloured enamel exposing the underlying dentine. Demineralisation involving the inner third of dentine

carious lesions: preventive standard care (or maintenance) and preventive active care.

Preventive *standard* care is indicated for low susceptibility patients in order to reduce the risk of recurrence of further disease (Table 3). This regimen includes daily oral hygiene (tooth brushing, use of fluoride toothpaste and inter-dental flossing), dietary advice as required and patient motivation. For patients who have not developed any new lesions over the past three years, this form of preventive strategy can be compared to conventional maintenance therapy. Individual oral health and diet prescription forms can be interesting tools for patient education and motivation (Figures 3 and 4). Individuals highly susceptible to caries can be provided with preventive *active* care, which includes the standard care regimen listed above plus professional decontamination, remineralisation, management of aetiological factors and the judicious use of fissure sealants (Table 3).

Decontamination

The modification of the oral microflora is an essential step of the MI approach of caries management[1,4]. Several options are available to rebalance the microflora, all of which can be used singly or in combination with one another:

- Professional Mechanical Tooth Cleaning (PMTC) involves the removal of dental plaque from all tooth surfaces using an ultrasonic scaler and fluoride prophypaste with a polishing brush. It has been stated that even if caries is a multifactorial disease, dental plaque is *the* only cause and that "no one would question the old concept that a clean tooth never decays"[17].

Table 2: Patient susceptibility chart. Listed are the major factors that, in combination, will provide a useful assessment of caries susceptibility. For simplicity, the rating of susceptibility has been limited to favourable or unfavourable.

Status	**"Yes" answer UNFAVOURABLE**	**"No" answer FAVOURABLE**
Lesions ≥2 new/progressing /restored lesions in the last 2 to 3 years?[72]		
General factors		
Diet Frequent snacks between meals? Anorexia, bulimia?[73-78]		
Fluoride No fluoride (toothpaste/rinse daily, fluoridated community)?[73,79,80]		
Health Sjögren's Syndrome, chemotherapy, radiation to head and neck?[81]		
Medications Hyposalivatory medication?[81,82]		
Social Low socio-economic status?[73,83-85]		
Age Adolescent? Elderly?[78,86,87]		
Oral factors		
OHI[77,88-91]		
Saliva Stimulated saliva flow <0.7ml/min?[92]		
Plaque Readily visible heavy plaque?[86]		
Bacterial balance[86,93,94]		

Table 3: Patient-centred management pathways based on lesion development and caries susceptibility, linked to the MITP flowcharts (Figures 1 and 2).

	Lesions			No Lesion	
	Cavitated (Irreversible)	**Non-cavitated (Reversible)**			
IDENTIFY	Lesion score: 3,4 High Susceptibility	Lesion score: 0-2 High Susceptibility	Lesion score: 0-2 Low Susceptibility	High Susceptibility	Low Susceptibility
PREVENT	**Active Care PLUS** Fissure Sealants + Motivation	**Active Care** Remineralisation products: Fluoride, CPP-ACP, Recaldent™ MI Paste Plus™ Cervitec™ Motivation	**Active Care** Remineralisation products: Fluoride, CPP-ACP, Recaldent™ Motivation	**Active Care** MI Paste Plus™ Cervitec™ Motivation	**Standard Care** Tooth Mousse™ (Desensitizing)
RESTORE	Transitional restorations: (GIC) Long term restorations (Equia™ GCC, Tokyo, Japan Composites)	Fissure Sealants	Fissure Sealants		
RECALL	2-6 months	3-6 months	6 months	6-12 months	12–18 months

- Prescription of periodic use chlorhexidine mouth-wash alongside PMTC in some cases such as patients with severe periodontitis or after a surgical procedure[1].
- High quality transitional / stabilizing restorations can be placed after excavation of caries-infected dentine which will remove the grossly infected biomass and also eliminate the areas of plaque re-tention[1,4]. The ideal material for this type of restoration is a high-viscosity glass ionomer cement (GIC) because of its adhesive properties, its capacity to act as an ionic fluoride reservoir and its capacity to exchange ions with demineralised dental tissues[18]. The Atraumatic Restorative Technique (ART) (manual excavation of infected dentine, GIC restoration performed using press-finger tech-nique) can be easily performed in every day practice with success in both children and adult patients alike[19-22]. Trans-itional restorations can also be considered as one of the first steps for patient education to tooth brushing by decreasing the discomfort / pain caused by brushing on exposed dentine.

Final restorations using more sophisticated techniques (e.g. composite restorations, inlays, onlays) are not indicated until the caries risk factors are under control.

Remineralisation

The effect of topical fluoride on enamel remineralisation is well described[23]. Reviews recently published by The Cochrane Collab-oration reported the effective-ness of fluoride toothpaste, varnish, gel and mouthwash in prevention of caries in children and adolescents[24-27].

More recently, the casein derivatives and specifically, Casein Phosphopeptide- Amorphous Calcium Phosphate (CPP-ACP, Recaldent™) has been developed and studied for its capacity to deliver higher amounts of phosphate and calcium ions on the tooth surface (Clinical Case 1). Despite the conclusion of Azarpazhooh and Limeback's review stating that there is a lack of double-blind, randomised, clinical trials without any loss[28], CPP-ACP (Recaldent™)-based remineralisation technologies are promising as adjunctive treatments to topical fluoride in prevention of the caries disease and in the non-invasive management of early caries lesions, especially in high risk individuals[29].

Management of saliva aetiological factors

The role of saliva in the neu-tralisation of acids produced within dental plaque biofilm and its involvement in the remineralisation of enamel is well-documented[30,31]. Thus, all the medical conditions or treatments affecting saliva in terms of flow and composition, can affect the protective role of saliva in the carious process, so increasing the patient's susceptibility to disease. Also, conditions leading to an acidic oral environment such as a high acidic drink intake, anorexia or gastro-oesophageal reflux have to be considered and controlled to prevent loss of tooth structure and integrity. Along with the modification of the oral microflora, some simple advice can be given to the patient to help rebalance the oral environment. Cheese or milk consumption can counterbalance an acidic intake as

Clinical Case 1: Complex demineralisation situation treated with CPP-ACP, Recaldent ™ (MI Paste Plus™, GCC, Tokyo, Japan) Clinical case from Dr M. Basso.

can waiting before tooth brushing after an acid attack[32,33]. The use of chewing gum can promote saliva stimulation, increasing flow output and buffering capacity[30,31,34]. Gum supplemented with xylitol and CPP-ACP may increase its re-mineralisation potential[34-38]. For dry mouth conditions, mouthrinses and toothpastes containing baking soda may decrease of the levels of cariogenic *S. mutans* in saliva and plaque[39]. Patient comfort products like Dry Mouth gel™ (GCC Tokyo, Japan) or salivary substitutes can also be prescribed[40].

Fissure protection

Fissure sealants and surface protection have been recognized as effective techniques to prevent pit and fissure caries in children[41-45]. They provide a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures. Sealants should be placed as soon as possible on pits and fissures of temporary and immature permanent teeth for highly susceptible patients[45] (Clinical Case 2).

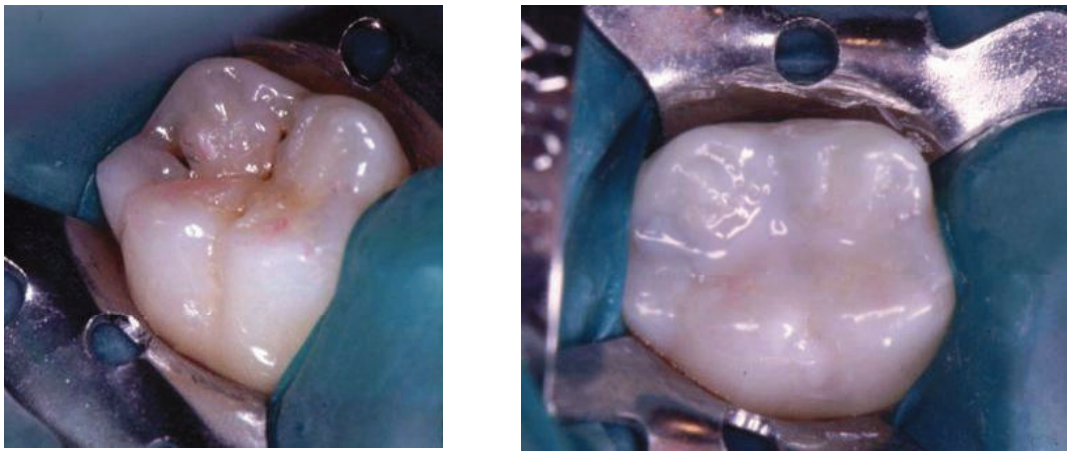
Figure 3: An example of an oral hygiene prescription form which can act as a longitudinal record of the patient's oral hygiene behaviour and a powerful motivational tool.

Figure 4: An example of a simple diet prescription form that can aid patient understanding of the effects of diet on disease susceptibility, so enabling the patient to control their own future oral health management strategies.

Essentially, two types of pit and fissure sealant materials are currently available: flowable composite resin and GIC. Their different indications depend mostly on the clinical situation. GICs, during placement, are less sensitive to moisture than resin-based sealants. Thus, GICs are recommended in situations where placing a rubber dam is not possible (e.g. early eruption stage, phobic patients, young children)[42,44-46]. Moreover, Beiruti et al. showed that high-viscosity GIC sealants have a four times higher chance of preventing caries development in re-exposed pits and fissures of occlusal surfaces in first molars than light-cured composite resin sealant material over a 1- to 3-year period[47].

MITP third phase - MI RESTORE

The goal of the MI approach is to stop/prevent the carious process but if the lesion has progressed to cavitation, restoration is the only way to rebuild the structural integrity and physiological function of the dentition. Also, the re-establishment of a smooth tooth-restoration surface



Clinical Case 2: Fissure Protection. The patient was placed at high caries susceptibility due to the presence of several cavitated lesions. Composite sealants placed on the deep occlusal fissures of molars as fissure protection. Clinical Case from Dr S. Doméjean-Orliaguet.

to aid oral hygiene procedures and to reduce the colonization of a cariogenic plaque microflora, is of paramount importance[1].

Restorative interventions in the MI philosophy are based on the principle of maximal preservation of natural tooth structure and on the use of biomimetic materials[1]. Depending on the loss of tooth structure, the depth of the lesion and the individual caries susceptibility, different restorative options have to be considered: a non-invasive restorative technique (e.g. remineralisation therapies and therapeutic sealants)[48-51], or a minimally invasive restorative technique (Clinical Case 3).

With respect to the MI treatment philosophy, the "surgical" excisional approach to caries should be undertaken only as a last resort[1,4,7]. In that philosophy, neither enamel nor dentine should be removed simply because it has lost calcium and phosphate ions as a result of acid attack. Non-invasive procedures have to be taken into account in the decision process as no current restorative material can perfectly replace or mimic natural tooth structure in the long term. The application of specific remineral-isation products (e.g. fluoride, Recaldent™) on damaged tooth surfaces may heal demineralised tooth structure (Clinical Case 1).

Clinical Case 3: The second inferior premolar presented a carious lesion of the distal surface.The minimal invasive cavity preparation includes only the proximal surface: slot technique. The dental material chosen for the restoration is a GIC.
Clinical case from Dr J. Zalba

Clinical Case 4: Defective amalgam restoration replacement by with long term GIC restoration (Equia™, GCC, Tokyo, Japan). The patient was placed at high caries susceptibility mainly because of poor oral hygiene and many failed amalgam restorations. Previous amalgam restorations were removed; infected dentin was excavated, GIC restorations were placed and oral hygiene instruction given. If the caries susceptibility decreases, more sophisticated and complex restorations could be performed with resin composite. Clinical case from Dr M. Basso

Enamel lesions can be remineralised (see MITP second phase- *MI Prevent*). Moreover, if lesions have not clinically cavitated, but have still histological penetrated dentine, there is potential for the overlying demineralised enamel to be remineralised using topical solutions and, in conjunction with the preventive measures outlined in the previous section, this can help to arrest further disease development. Also, there is evidence that lesions where the caries-infected and affected dentine are sealed beneath a well-placed adhesive restoration or therapeutic sealants, do not clinically or radiographically progress over at least 10 years[50]. Of course, success will depend on numerous factors, including the size and depth of the lesion and the various patient factors including susceptibility factors, compliance to oral hygiene / dietary recommendations and recall. However, once a decision is made to surgically intervene (excessive loss of tooth structure, high patient susceptibility, low patient compliance), then minimally invasive strategies have to be considered. The main principle of the MI Restore is to limit the three-dimensional extent of caries removal. Extension for prevention[52] is no longer a tenable concept according to current knowledge of the carious process and the developments of adhesive restorations[53]. Only the removal of highly infected dentine biomass is required and affected dentine close to the pulp, which has a potential of remineralisation, can be retained and modified to "caries-inactive" when an overlying, sealed adhesive restoration is placed[54,55]. Adopting the minimally invasive strategy of repairing previous restorations[9] or placement of small restorations in small cavities and providing an adequate seal using adhesive restorative materials, allow the tooth structure a chance to heal.

Another consideration is the type of restorative material to be used. The MI restoration placed by the dentist with knowledge of the chemistry of the dental materials and their clinical handling characteristics, is likely to be successful for many years assuming the patient can maintain a favourable oral environment. Current materials of choice include dental resin composites and GICs. Resin composite has well reported advantages of high quality aesthetics, surface finish, wear resistance and strength. Advantages of 'bio-active' GIC include the self-adhesive chemical bond to tooth structure, the release of fluoride ions into subjacent dentine layers and its

relative simplicity of placement when compared to resin composite[18,56]. When compared to resin composite, GIC generally shows lower resistance to compressive forces, rapid surface abrasion, evidence of marginal leakage and a less satisfactory long-term aesthetic appearance. In recent years, GIC chemistry has been developed in order to overcome some of these problems, so extending their indications for use. Recently, a new system coating GIC with a nano-filled light-cured resin (EQUIA™ Fuji IX GP Extra™ with G-Coat Plus™ GCC Tokyo, Japan) has been shown to improve the wear resistance and hardness of the restoration[57] (Clinical Case 4).

MITP fourth phase – MI RECALL

MITP is based on the susceptibility of each patient and is customized according to the specific aetiological factors involved in each clinical case. Its success is largely dependent on the tailored preventive procedures and on the follow-up regimen. The main objectives of the MI recall visit are to control the oral balance, to prevent oral disease and possibly to detect and treat it at an early stage.

A recent systematic review on the subject published by the Cochrane Collaboration pointed out that there is still an ongoing international debate in relation to the clinical effectiveness and cost-effectiveness of recall intervals for specific types of care[58]. Furthermore, the literature shows that the recall frequency varies markedly according to the different recommendations and policies among and within countries for children and adults[59-64]. The MITP advisory board developed a consensus summarised in Table 3. Table 4 presents in detail how to structure the MI recall examination.

In order to customize the MI recall frequency, several important points have to be kept in mind:

- ***The carious process is a slow process:*** It takes about two years for a carious lesion to progress through the enamel. Patients aged 12 years or older having recall dental examinations at intervals longer than 6 months are not disadvantaged as they do not exhibit more severe dental caries or periodontal disease than those attending at intervals of 6 months[65].

- ***Living in a fluoridated area retards lesion progression:*** Residence in a fluoridated area has a marked retarding effect on both enamel and dentinal lesion progression[66,67]. A clinical study conducted in 1996 in Brazil among schoolchildren specified that the lesion progression from the outer half of enamel into the outer half of dentine takes approximately 3-4 years in schoolchildren from the fluoridated areas and 2½ years in the non-fluoridated areas[66].

- ***Age can be a predisposing factor:*** In a low caries prevalence population, both the incidence of new caries lesions and that of lesion progression are lower during young adulthood than during adolescence. The risk of both new approximal enamel lesions and lesion progression is clearly greatest during early adolescence, in the first 2–3 years after eruption[68,69]. For the elderly patient, professional support may be required for prolonged periods of time until efficient control could be achieved[70].

Table 4: How to structure the MI recall examination? Why and how to do it?

Factors	What? Why?	How?
General health	Up-date of the medical history	☞Patient's interview ☞Questionnaire
Oral health review	Up-date of the dental history	☞Patient's interview ☞Questionnaire
Comprehensive oral environment	Plaque control	☞Plaque indicator ☞Plaque pH test
	Bacteria assessment	☞Bacteria test
	Saliva assessment	☞pH test ☞Buffer capacity test
Tooth surface integrity	Interception of: - Incipient lesions - Defective sealants - Defective restorations (Fracture, open margins, sensitivity)	☞Visual exam ☞Use of magnification ☞"Gentle" probing as recommended by the ICDAS committee (ball-ended probe) ☞Bitewings radiographs
Effectiveness of the preventive regimen	Remineralisation control Early lesions stabilisation	☞Visual exam ☞Bitewings radiographs ☞QLF (Quantitative Light Fluorescence) for mineral content assessment ☞Dietary habit questionnaire
Re-assessment of the caries susceptibility	Pathological factors Protective factors	☞Same procedure as the baseline susceptibility assessment
Re-assessment of the patient's motivation and compliance	Patient education	☞Patient's interview ☞Comparison with previous results
↓↓↓↓↓↓↓↓		
Re-adjustment of the MITP	Re-adjustment of: - The preventive regimen - The restorative regimen - The recall frequency	☞According to: - The up-dated patient's susceptibility - The patient's demand - The clinical judgement of the dental team - The Health System in which the practitioner is working through

- ***The health system of each country has to be considered:*** As an example, in the UK, following NHS regulations in the General Dental Service, dental practitioners are encouraged to perform 6-monthly check-ups and registration with an NHS dentist lapses after a 15-month gap between visits[71].

- ***The recall frequency has to be adjusted to patient's response to treatment:*** At each recall appointment, the interval should be reviewed according to the patient's responses to the oral care provided and the health outcomes. Patients should be informed that their re-commended recall interval may vary over time[60].

Conclusions

- MITP is introduced as a simple patient-centred approach to MI oral health management in general dental practice.
- The successful implemen-tation of MI requires a team approach ideally, involving the dentist co-ordinating care between the dental hygienist, therapist, oral health educator and dental nurse, adjusted to the relevant health care system.
- MI relies on a primary holistic/oral physician's approach to the management of dental caries
- MI applies to all patient groups, with suitable adaptation when appropriate.
- The MI Advisory Board presents an easy to follow, step-by-step flowchart to be used in daily practice (Figure 2).

摘引
在过去的十年中，牙科学已经发生了完全的转变。
最有趣但尚未完全实际应用的话题之一是最小干预（**MI**）牙科。最小干预（**MI**）的概念在文献中被广泛描述，并总结了在龋齿学中防治及病因相关方法的临床基本原理。 由泛欧学者和开业者组成的 **GC** 欧洲 **"MI** 顾问委员会**"**致力于为日常临床牙科实践提供一种循证的**MI**治疗方法。
这种治疗的方法论是基于其非常简单的**4**步治疗计划，亦即**MI**发现、**MI**防治、**MI**复诊及**MI**修复。**MI** 发现 这一阶段包括 **/** 强调**"**不仅仅**"**寻找龋齿，并且要发现影响病人易感性的因素。 参照修订过的 **ICDAS** 标准，以便获取龋患的临床症候，咬翼片也使用类似的放射标准。
此外，其它因素，例如菌斑和唾液的质量也可通过使用各种简单易行的技术找出。
然后将所有这些信息评估，以确认病人的易感性，做出诊断并做出防治计划。 **MI** 预防及 **MI** 复诊
根据病人的易感性和风险因素，建立预防性治疗体系。
"标准**"**方法包括口腔卫生推荐、饮食建议、病人激励和保持。
那些具有高风险因素的病人需要**"**活跃的**"**防治护理。
措施包括降低口腔窝洞细菌含量、放置过渡性修复材料以及使用再矿化介质。
对于风险因素反复诊断来确定需要采取的防治措施的精确级别以及为每个病人个性化设置的复诊时间。 **MI** 修复 **MI** 修复在不得不进行修补时提供保存牙组织的技术。
区分了非侵害和侵害技术的差别。
这一部分包括**"**非侵害**"**或**"**修复方法**"**取得成功的临床病例表述。

Resumen

La odontología se ha trans-formado completamente durante aproximadamente la última década. Uno de los temas más interesantes y que aún no se aplica completamente en la práctica, es la Mínima Intervención (MI) en Odonto-logía. El concepto de Mínima Intervención (MI) se describe adecuadamente en la literatura,

y resume la lógica clínica del enfoque en la prevención y la causa en cariología. La Junta Consultiva de MI de GC Europe (GC Europe MI Advisory Board), que es un grupo paneuropeo de académicos y médicos generales, tiene como propósito presentar un enfoque de tratamiento MI basado en evidencia, para la práctica dental clínica rutinaria. Esta metodología de tratamiento se basa en su propio planeamiento de 4-Fases de Tratamiento; por ejemplo, Identificación MI, Prevención MI, Citación MI, y Restauración MI. Identificación MI Esta fase abarca/pone énfasis 'no sólo' en ubicar la caries sino también en identificar los factores que afectan la susceptibilidad del paciente. Nos remitimos tanto al criterio modificado de ICDAS (a fin de acceder a los signos clínicos de caries) como a criterios radiológicos similares (para aletas de mordida). Además, mediante varias técnicas de fácil aplicación, se identifican otros factores como calidad de la placa y saliva. Luego se evalúa toda esta información para calcular la susceptibilidad del paciente, establecer un diagnóstico y constituir un plan de tratamiento preventivo. Prevención MI y Citación MI Dependiendo de la susceptibilidad y factores de riesgo del paciente, se establecen los reglamentos de tratamiento preventivo. El enfoque 'estándar' incluye recomendaciones de higiene oral, asesoramiento dietético, motivación y mantenimiento del paciente. Aquellos pacientes con factores de alto riesgo necesitan de cuidado preventivo 'activo', el cual incluye medidas para disminuir el contenido bacterial de la cavidad oral, colocación de restauraciones transitorias y uso de agentes remineralizantes. Se utilizará un diagnóstico reiterado de los factores de riesgo a fin de evaluar, de manera individualizada para cada paciente, la necesidad de nivel exacto de medidas preventivas y el número de citaciones. Restauración MI Restauración MI presenta técnicas para la conservación de la estructura dental cuando se requiera colocar restauraciones. Se hacen distinciones entre técnicas no invasivas e invasivas. Esta sección incluye la presentación de casos clínicos en donde el enfoque 'no invasivo' o 'de restauración' han demostrado tener éxito.

References

1. Mount GJ, Ngo H. Minimal intervention: a new concept for operative dentistry. Quintessence Int 2000; 31: 527-33.
2. Anusavice KJ. Criteria for placement and replacement of dental restorations. Fla Dent J 1988; 59: 30-1.
3. Featherstone JD. The science and practice of caries prevention. J Am Dent Assoc 2000; 131: 887-99.
4. Mount GJ, Ngo H. Minimal intervention: early lesions. Quintessence Int 2000; 31: 535-46.
5. Mount GJ, Ngo H. Minimal intervention: advanced lesions. Quintessence Int 2000; 31: 621-9.
6. Tyas MJ, Anusavice KJ, Frencken JE, Mount GJ. Minimal intervention dentistry--a review. FDI Commission Project 1-97. Int Dent J 2000; 50: 1-12.
7. Ericson D, Kidd E, McComb D, Mjor I, Noack MJ. Minimally Invasive Dentistry--concepts and techniques in cariology. Oral Health Prev Dent 2003; 1: 59-72.
8. Mount GJ. A new paradigm for operative dentistry. Aust Dent J 2007; 52: 264-70.

9. Moncada G, Fernandez E, Martin J, Arancibia C, Mjor IA, Gordan VV. Increasing the longevity of restorations by minimal intervention: a two-year clinical trial. Oper Dent 2008; 33: 258-64.
10. Pitts N. "ICDAS"-- an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. Community Dent Health 2004; 21: 193-8.
11. ICDAS-Commitee. International Caries Detection and Assessment System II (ICDAS II); 2005.
12. Ekstrand K, Qvist V, Thylstrup A. Light microscope study of the effect of probing in occlusal surfaces. Caries Res 1987; 21: 368-74.
13. Kuhnisch J, Dietz W, Stosser L, Hickel R, Heinrich-Weltzien R. Effects of dental probing on occlusal surfaces--a scanning electron microscopy evaluation. Caries Res 2007; 41: 43-8.
14. Wenzel A. Bitewing and digital bitewing radiography for detection of caries lesions. J Dent Res 2004;83 Spec No C: C72-5.
15. Zandona AF, Zero DT. Diagnostic tools for early caries detection. J Am Dent Assoc 2006; 137: 1675-84.
16. Bader JD, Shugars DA. The evidence supporting alternative management strategies for early occlusal caries and suspected occlusal dentinal caries. J Evid Based Dent Pract 2006; 6: 91-100.
17. Fejerskov O. Concepts of dental caries and their consequences for understanding the disease. Community Dent Oral Epidemiol 1997; 25: 5-12.
18. Ngo HC, Mount G, Mc Intyre J, Tuisuva J, Von Doussa RJ. Chemical exchange between glass-ionomer restorations and residual carious dentine in permanent molars: an in vivo study. J Dent 2006; 34: 608-13.
19. van 't Hof MA, Frencken JE, van Palenstein Helderman WH, Holmgren CJ. The atraumatic restorative treatment (ART) approach for managing dental caries: a meta-analysis. Int Dent J 2006; 56: 345-51.
20. Frencken JE, van't Hof MA, Taifour D, Al-Zaher I. Effectiveness of ART and traditional amalgam approach in restoring single-surface cavities in posterior teeth of permanent dentitions in school children after 6.3 years. Community Dent Oral Epidemiol 2007; 35: 207-14.
21. Mickenautsch S, Frencken JE, van't HM. Atraumatic restorative treatment and dental anxiety in outpatients attending public oral health clinics in South Africa. J Public Health Dent 2007; 67: 179-84.
22. Steele J. ART for treating root caries in older people. Evid Based Dent 2007; 8: 51.
23. Fejerskov O, Larsen MJ, Richards A, Baelum V. Dental tissue effects of fluoride. Adv Dent Res 1994; 8: 15-31.
24. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride gels for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2002: CD002280.
25. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride varnishes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2002: CD002279.

26. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride mouthrinses for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2003: CD002284.
27. Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2003: CD002278.
28. Azarpazhooh A, Limeback H. Clinical efficacy of casein derivatives: a systematic review of the literature. J Am Dent Assoc 2008; 139: 915-24.
29. Reynolds EC. Calcium phosphate-based remineralization systems: scientific evidence? Aust Dent J 2008; 53: 268-73.
30. Dawes C. Salivary flow patterns and the health of hard and soft oral tissues. J Am Dent Assoc 2008; 139 Suppl: 18S-24S.
31. Stookey GK. The effect of saliva on dental caries. J Am Dent Assoc 2008; 139 Suppl: 11S-17S.
32. Herod EL. The effect of cheese on dental caries: a review of the literature. Aust Dent J 1991; 36: 120-5.
33. Kashket S, DePaola DP. Cheese consumption and the development and progression of dental caries. Nutr Rev 2002; 60: 97-103.
34. Ly KA, Milgrom P, Rothen M. The potential of dental-protective chewing gum in oral health interventions. J Am Dent Assoc 2008; 139: 553-63.
35. Iijima Y, Cai F, Shen P, Walker G, Reynolds C, Reynolds EC. Acid resistance of enamel subsurface lesions remineralized by a sugar-free chewing gum containing casein phosphopeptide-amorphous calcium phosphate. Caries Res 2004; 38: 551-6.
36. Burt BA. The use of sorbitol- and xylitol-sweetened chewing gum in caries control. J Am Dent Assoc 2006; 137: 190-6.
37. Deshpande A, Jadad AR. The impact of polyol-containing chewing gums on dental caries: a systematic review of original randomized controlled trials and observational studies. J Am Dent Assoc 2008; 139: 1602-14.
38. Manton DJ, Walker GD, Cai F, Cochrane NJ, Shen P, Reynolds EC. Remineralization of enamel subsurface lesions in situ by the use of three commercially available sugar-free gums. Int J Paediatr Dent 2008; 18: 284-90.
39. Drake D. Antibacterial activity of baking soda. Compend Contin Educ Dent Suppl 1996; 17: S17-21.
40. Navabifard Jahromi A, Kasaie E, Bots CO, Brand HS. Preferences and saliva stimulation of six different dry mouth gels. IADR 2008.
41. Ahovuo-Saloranta A, Hiiri A, Nordblad A, Worthington H, Makela M. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. Cochrane Database Syst Rev 2004: CD001830.
42. Hiiri A, Ahovuo-Saloranta A, Nordblad A, Makela M. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in children and adolescents. Cochrane Database Syst Rev 2006: CD003067.
43. Ahovuo-Saloranta A, Hiiri A, Nordblad A, Makela M, Worthington HV. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. Cochrane Database Syst Rev 2008: CD001830.
44. Beauchamp J, Caufield PW, Crall JJ, Donly K, Feigal R, Gooch B, et al. Evidence-based clinical recommendations for the use of pit-and-fissure sealants: a report of the American Dental Association Council on Scientific Affairs. J Am Dent Assoc 2008; 139: 257-68.

45. Deery C. Pits and fissure sealant guidelines. Summary guideline. Evid Based Dent 2008; 9: 68-70.
46. Yip HK, Smales RJ. Glass ionomer cements used as fissure sealants with the atraumatic restorative treatment (ART) approach: review of literature. Int Dent J 2002; 52: 67-70.
47. Beiruti N, Frencken JE, van 't Hof MA, van Palenstein Helderman WH. Caries-preventive effect of resin-based and glass ionomer sealants over time: a systematic review. Community Dent Oral Epidemiol 2006; 34: 403-9.
48. Elderton RJ. Management of early dental caries in fissures with fissure sealant. Br Dent J 1985;158: 254-8.
49. Elderton RJ. Overtreatment with restorative dentistry: when to intervene? Int Dent J 1993; 43: 17-24.
50. Mertz-Fairhurst EJ, Curtis JW, Jr., Ergle JW, Rueggeberg FA, Adair SM. Ultraconservative and cariostatic sealed restorations: results at year 10. J Am Dent Assoc 1998; 129: 55-66.
51. Griffin SO, Oong E, Kohn W, Vidakovic B, Gooch BF, Bader J, et al. The effectiveness of sealants in managing caries lesions. J Dent Res 2008; 87: 169-74.
52. Black GV. A work on operative dentistry. Chicago: The medico-dental Publ. Co; 1908.
53. Elderton RJ. Iatrogenesis in the treatment of dental caries. Proc Finn Dent Soc 1992; 88: 25-32.
54. Wambier DS, dos Santos FA, Guedes-Pinto AC, Jaeger RG, Simionato MR. Ultrastructural and microbiological analysis of the dentin layers affected by caries lesions in primary molars treated by minimal intervention. Pediatr Dent 2007; 29: 228-34.
55. Oong EM, Griffin SO, Kohn WG, Gooch BF, Caufield PW. The effect of dental sealants on bacteria levels in caries lesions: a review of the evidence. J Am Dent Assoc 2008; 139: 271-8.
56. Xie D, Zhao J, Weng Y, Park JG, Jiang H, Platt JA. Bioactive glass-ionomer cement with potential therapeutic function to dentin capping mineralization. Eur J Oral Sci 2008; 116: 479-87.
57. Magni E, Zhang L, Hickel R, Bossu M, Polimeni A, Ferrari M. SEM and microleakage evaluation of the marginal integrity of two types of class V restorations with or without the use of a light-curable coating material and of polishing. J Dent 2008; 36: 885-91.
58. Beirne P, Clarkson JE, Worthington HV. Recall intervals for oral health in primary care patients. Cochrane Database Syst Rev 2007: CD004346.
59. ANDEM. Recommandations et références dentaires. 1996.
60. NICE. Dental recall: Recall interval between routine dental examinations: National Institute for Clinical Excellence; 2004.
61. SFOP. Recommandations sur la prescription des fluorures de la naissance à l'adolescence. Recommandations sur la pratique de scellement des puits et fissures. Journal d'Odonto-Stomatologie Pédiatrique 2004; 11.
62. Tan EH, Batchelor P, Sheiham A. A reassessment of recall frequency intervals for screening in low caries incidence populations. Int Dent J 2006; 56: 277-82.
63. Jenson L, Budenz AW, Featherstone JD, Ramos-Gomez FJ, Spolsky VW, Young DA. Clinical protocols for caries management by risk assessment. J Calif Dent Assoc 2007; 35: 714-23.
64. Ramos-Gomez FJ, Crall J, Gansky SA, Slayton RL, Featherstone JD. Caries risk assessment appropriate for the age 1 visit (infants and toddlers). J Calif Dent Assoc 2007; 35: 687-702.

65. Sheiham A. Is there a scientific basis for six-monthly dental examinations? Lancet 1977; 2: 442-4.
66. Lawrence HP, Benn DK, Sheiham A. Digital radiographic measurement of approximal caries progression in fluoridated and non-fluoridated areas of Rio de Janeiro, Brazil. Community Dent Oral Epidemiol 1997; 25: 412-8.
67. Arrow P. Incidence and progression of approximal carious lesions among school children in Western Australia. Aust Dent J 2007; 52: 216-26.
68. Stenlund H, Mejare I, Kallestal C. Caries rates related to approximal caries at ages 11-13: a 10-year follow-up study in Sweden. J Dent Res 2002; 81: 455-8.
69. Mejare I, Stenlund H, Zelezny-Holmlund C. Caries incidence and lesion progression from adolescence to young adulthood: a prospective 15-year cohort study in Sweden. Caries Res 2004; 38: 130-41.
70. University of Illinois at Chicago. Dental caries treatment as an infectious disease: http://www.uic.edu/classes/peri/peri343/main2.htm.
71. Davenport CF, Elley KM, Fry-Smith A, Taylor-Weetman CL, Taylor RS. The effectiveness of routine dental checks: a systematic review of the evidence base. Br Dent J 2003; 195: 87-98.
72. van Palenstein Helderman WH, van't Hof MA, van Loveren C. Prognosis of caries increment with past caries experience variables. Caries Res 2001; 35: 186-92.
73. NIH. Diagnosis and management of dental caries throughout life. National Institutes of Health Consensus Development Conference statement, March 26-28, 2001. J Dent Educ 2001; 65: 1162-8.
74. Sheiham A. Dietary effects on dental diseases. Public Health Nutr 2001; 4: 569-91.
75. van Loveren C, Duggal MS. Experts' opinions on the role of diet in caries prevention. Caries Res 2004; 38 Suppl 1: 16-23.
76. Zero DT. Sugars - the arch criminal? Caries Res 2004; 38: 277-85.
77. Burt BA. Concepts of risk in dental public health. Community Dent Oral Epidemiol 2005; 33: 240-7.
78. Fontana M, Zero DT. Assessing patients' caries risk. J Am Dent Assoc 2006; 137: 1231-9.
79. Newbrun E. Topical fluorides in caries prevention and management: a North American perspective. J Dent Educ 2001; 65: 1078-83.
80. Featherstone JD. The continuum of dental caries--evidence for a dynamic disease process. J Dent Res 2004; 83 Spec No C: C39-42.
81. Navazesh M, Brightman VJ, Pogoda JM. Relationship of medical status, medications, and salivary flow rates in adults of different ages. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1996; 81: 172-6.
82. Moore PA, Guggenheimer J. Medication-induced hypo-salivation: etiology, diagnosis, and treatment. Compend Contin Educ Dent 2008; 29: 50-5.
83. Reisine ST, Psoter W. Socioeconomic status and selected behavioral determinants as risk factors for dental caries. J Dent Educ 2001; 65: 1009-16.
84. Azogui-Levy S, Lombrail P, Riordan PJ, Brodin M, Baillon-Javon E, Pirlet MC, et al. Evaluation of a dental care program for school beginners in a Paris suburb. Community Dent Oral Epidemiol 2003; 31: 285-91.

85. Adam C, Eid A, Riordan PJ, Wolikow M, Cohen F. Caries experience in the primary dentition among French 6-year-olds between 1991 and 2000. Community Dent Oral Epidemiol 2005; 33: 333-40.
86. Reich E, Lussi A, Newbrun E. Caries-risk assessment. Int Dent J 1999; 49: 15-26.
87. Alian AY, McNally ME, Fure S, Birkhed D. Assessment of caries risk in elderly patients using the Cariogram model. J Can Dent Assoc 2006; 72: 459-63.
88. van Rijkom HM, Truin GJ, van 't Hof MA. A meta-analysis of clinical studies on the caries-inhibiting effect of chlorhexidine treatment. J Dent Res 1996; 75: 790-5.
89. Caufield PW, Dasanayake AP, Li Y. The antimicrobial approach to caries management. J Dent Educ 2001; 65: 1091-5.
90. Gisselsson H, Emilson CG, Birkhed D, Bjorn AL. Approximal caries increment in two cohorts of schoolchildren after discontinuation of a professional flossing program with chlorhexidine gel. Caries Res 2005; 39: 350-6.
91. Hujoel PP, Cunha-Cruz J, Banting DW, Loesche WJ. Dental flossing and interproximal caries: a systematic review. J Dent Res 2006; 85: 298-305.
92. Leone CW, Oppenheim FG. Physical and chemical aspects of saliva as indicators of risk for dental caries in humans. J Dent Educ 2001; 65: 1054-62.
93. Loesche WJ. Role of Streptococcus mutans in human dental decay. Microbiol Rev 1986; 50: 353-80.
94. van Houte J. Role of micro-organisms in caries etiology. J Dent Res 1994; 73: 672-81.